**Fluids Summary Sheet - Physics**

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| **Properties of Fluids** |
| **Fluid**: A state of matter in which the component particles (generally molecules) can move past one another. Fluids flow easily and conform to the shape of their containers.   1. Liquids and Gases are fluids 2. Mass Density = ρ = m/V (kg/m3) 3. Weight Density = ρg (N/m3). 4. Specific Gravity (SG) = ρsubstance / ρwater (no units). SGwater = 1.0 5. Pressure = F/A N/m2 (Pascals or Pa). Produces forces perpendicular to each surface it is in contact with. 6. Atmospheric Pressure: 1.013 x 105 Pa = pressure at sea level. |
| **Static Pressure in Fluids** |
| 1. Pressure of a fluid is related to the depth of the fluid   P2 = P1 + ρgh where h = depth   1. Pressure due to depth of a fluid does not depend on the shape or horizontal distances, only the vertical depth. 2. Pressure Gauges measure the pressure of a fluid  * Absolute pressure is the actual pressure * Gauge pressure is the pressure of a fluid relative to some reference (usually atmospheric): Pabsolute = Pgauge + Patmosphere  1. **Pascal’s Principle**: Any change in the pressure applied to a completely enclosed fluid is transmitted undiminished to all parts of the fluid and the enclosing walls. Pascal’s principle is put to use in all hydraulic machines. |
| **Buoyant Forces – Archimedes’ Principle** |
| 1. The **buoyant force** (FB) is equal to the **weight of displaced fluid**.   FB = (ρliquid)gVdisplaced liquid   * 1. The buoyant force is present for all objects immersed in a liquid and opposes the force of gravity.   2. An object will float if the maximum buoyant force is greater than the force due to gravity.   3. An object will sink if the maximum buoyant force is less than the force due to gravity. |

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| **Fluids in Motion** | |
| 1. **Kinds of Flow**    1. **Steady flow**: velocity of particles doesn’t change with time    2. **Unsteady flow**: velocity of particles changes with time. Turbulent flow is unsteady flow.    3. **Non-compressible** flow refers to fluids whose density does not change with pressure (most liquids – like water)    4. **Compressibl**e flow refers to fluids whose density can change with pressure (gases)    5. **Viscosity** hinders the ability of a fluid to slide past itself. Examples of high viscosity fluids are honey, oil, etc. 2. **Equation of Continuity**    1. Mass flow rate of a fluid remains constant = ρAv    2. ρA1*v*1 = ρA2*v*2 where A = area, *v* = speed of fluid; ρ = mass density 3. **Bernoulli’s Equation**    1. Conservation of mechanical energy in a flowing fluid    2. P1 + ½ρv12 + ρgy1 = P2 + ½ρv22 + ρgy2 = constant    3. Increased velocity leads to reduced pressure for constant height    4. Decreased velocity leads to increased pressure for constant height | |
| **Kinds of Problems** | |
| **Density and Pressure** | 1. Find density: mass/volume 2. Pressure: Force/Area 3. Pressure at depth: P2 = P1 + ρgh 4. Pabsolute = Pgauge + Patmospheric 5. U-Tubes: Lowest level of bottom fluid is the same pressure on both sides of the U Tube. 6. Pascal’s Principle: Use the fact that a pressure increase is transmitted throughout the fluid. F1/A1 = F2/A2 |
| **Buoyant Forces** | 1. FB = (ρliquid)gVdisplaced liquid 2. Will it float?: If maximum FB > Wobject, it will float. 3. How much of object is submerged: Determine how much displaced liquid is required; then calculate volume of object. |
| **Flowing Fluids** | 1. Mass flow rate: ρA1*v*1 = ρA2*v*2 A = area, *v* = speed of fluid 2. Pressure, height, or velocity changes: use Bernoulli’s equation:   P1 + ½ρv12 + ρgy1 = P2 + ½ρv22 + ρgy2 |